Color and Material Evaluation of Hydroxyapatite Layers Containing TiO2 Particles Fabricated by Powder Jet Deposition

論 文 内 容 要 旨

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[Objectives]

A powder jet deposition (PJD) process is used to create hydroxyapatite (HA) layers on human teeth. The fabricated HA layers demonstrated excellent microstructural and mechanical properties *in vitro* and *in vivo*. Titanium dioxide (TiO_2) changed the whiteness of the layers because of the selective reflection of light. This raises the possibility that TiO_2-HA layer deposition may improve new treatment for discolored teeth. The microstructural and mechanical properties of the TiO_2-HA layers, particularly the effects of thermal stress, the color change obtained, and the color stability of the layers after thermal cycling were evaluated.

[Materials and Methods]

The microstructural properties of the TiO_2-HA layers, namely surface thickness and roughness, were evaluated from scanning electron microscopy images and three-dimensional profiles. The mechanical properties of the layers were evaluated using micro-Vickers hardness and bonding strength tests. The CIE $L^*a^*b^*$ color system was used for color differences and translucency, and ΔE^* values were calculated before and after the fabrication of the TiO_2-HA layers. Photographs of specimens were taken with a digital camera for visual color evaluation. Furthermore, these material properties and color differences were evaluated before and after 500 thermal cycles (5–55°C).

[Results and Discussion]

The TiO_2-HA particles were densely packed in the layers, the maximum thickness of which was about 60 μm. There were no significant differences in thickness, surface roughness, hardness, or bonding strength before and after the thermal cycling procedure. Moreover, these properties of the TiO_2-HA layers were equivalent to those of HA layers fabricated by the PJD process. The TiO_2-HA layers showed increased L^* and decreased b^* parameter compared with those of the enamel substrate, and the color difference ΔE^* was approximately 6.7 units, indicating that the TiO_2-HA layers whitened the color of the treated tooth. Furthermore, it was confirmed from digital camera images that the TiO_2-HA layers showed low translucency and a visually perceptible level of whiteness. This color was retained even after thermal cycling.

[Conclusion]

The fabrication of TiO_2-HA layers by a PJD process may be a suitable new treatment for discolored teeth.